

December 11, 2007

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Mail Stop: OWFN, P1-35  
Washington, D. C. 20555-0001

10 CFR 50.73

Dear Sir:

**TENNESSEE VALLEY AUTHORITY - BROWNS FERRY NUCLEAR PLANT (BFN)  
- UNIT 1 - DOCKET 50-259 - FACILITY OPERATING LICENSE DPR - 33 -  
LICENSEE EVENT REPORT (LER) 50-259/2007-009-00**

The enclosed report provides details of an October 12, 2007, automatic reactor scram due to a turbine trip as a result of an invalid high level signal in the 1A1 moisture separator drain tank.

TVA's investigation into this event found that the turbine trip level switch instrument routing was the cause the event. The high level reference leg is routed to the moisture separator high point vent line and the low level reference leg is routed to the moisture separator drain piping.

Additionally, unique to Unit 1 only, the moisture separator high point vent line also has a 3 inch reducer in very close proximity to the turbine trip level switch high reference leg. Once the moisture separator is void of condensate, high velocity steam flow is established through the moisture separator, the presence of this reducer creates a venturi effect on the high level reference leg connection; thus, increasing the differential pressure between the moisture separator and the level control tank. This results in the high level reference leg having a lower pressure than the level reference leg, thus causing the turbine trip level switch floats to lift to above the trip setpoint.

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This event is similar to the event that occurred on June 9, 2007, reported in LER 259/2007-005. The root cause investigation for LER 259/2007-005 concluded that the dump valve for the moisture separator was oversized for the plant conditions. TVA's investigation into this event found that the dump valve for the moisture separator was oversized for the current plant conditions; however, it heavily contributed to both events.

Additional analysis and plant testing at full reactor power found that with the dump valve flow restricted to 30 percent, a turbine trip would not occur. So, as an interim measure until corrective actions to address the root cause can be implemented, TVA has restricted the flow through the dump valve.

TVA's corrective actions for both of the events include rerouting the instrument reference legs so that flow through the moisture separator cannot create a venturi effect on the instrument reference leg.

TVA is reporting this in accordance with 10 CFR 50.73(a)(2)(iv)(A), as an event that resulted in a manual or automatic actuation of the systems listed in paragraph 10 CFR 50.73(a)(2)(iv)(B) (i.e., Reactor Protection System including reactor scram or trip, and general containment isolation signals affecting containment isolation valves in more than one system). There are no commitments contained in this letter.

Sincerely,

Original signed by

Brian O'Grady

cc: See page 2

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Enclosure

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Enclosure

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## LICENSEE EVENT REPORT (LER)

(See reverse for required number of  
digits/characters for each block)

Estimated burden per response to comply with this mandatory collection request:: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

**1. FACILITY NAME**  
Browns Ferry Unit 1**2. DOCKET NUMBER**  
05000259**3. PAGE**  
1 of 5**4. TITLE:** Invalid High Level In Moisture Separator Results in Turbine Trip and Reactor Scram

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
10	12	2007	2007-009-00			12	11	2007	None	N/A
									None	N/A

**9. OPERATING MODE**

1

**11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)****10. POWER LEVEL**  
100

20.2201(b)	20.2203(a)(3)(i)	50.73(a)(2)(i)(C)	50.73(a)(2)(vii)
20.2201(d)	20.2203(a)(3)(ii)	50.73(a)(2)(ii)(A)	50.73(a)(2)(viii)(A)
20.2203(a)(1)	20.2203(a)(4)	50.73(a)(2)(ii)(B)	50.73(a)(2)(viii)(B)
20.2203(a)(2)(i)	50.36(c)(1)(i)(A)	50.73(a)(2)(iii)	50.73(a)(2)(ix)(A)
20.2203(a)(2)(ii)	50.36(c)(1)(ii)(A)	X 50.73(a)(2)(iv)(A)	50.73(a)(2)(x)
20.2203(a)(2)(iii)	50.36(c)(2)	50.73(a)(2)(v)(A)	73.71(a)(4)
20.2203(a)(2)(iv)	50.46(a)(3)(ii)	50.73(a)(2)(v)(B)	73.71(a)(5)
20.2203(a)(2)(v)	50.73(a)(2)(i)(A)	50.73(a)(2)(v)(C)	OTHER
20.2203(a)(2)(vi)	50.73(a)(2)(i)(B)	50.73(a)(2)(v)(D)	specify in Abstract below or in NRC Form 366A

**12. LICENSEE CONTACT FOR THIS LER****NAME**  
Steve Austin, Licensing Engineer, Licensing and Industry Affairs**TELEPHONE NUMBER (Include Area Code)**  
256-729-2070**13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT**

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

**14. SUPPLEMENTAL REPORT EXPECTED**

YES (If yes, complete 15. EXPECTED SUBMISSION DATE)

NO

**15. EXPECTED SUBMISSION DATE**

N/A

N/A

N/A

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced type written lines)

On October 12, 2007, at 0803 hours central daylight time (CDT), Unit 1 automatically scrambled following a turbine trip from a 1A1 main steam system moisture separator false high level signal. At approximately 0739 hours CDT, prior to the automatic turbine trip, the Unit 1 operator received an alarm indicating a low level in the 1A1 moisture separator drain tank. At 0803 hours CDT, Unit 1 received a moisture separator 1A1 high level turbine trip signal followed immediately by a reactor scram.

TVA submits this report in accordance with 10 CFR 50.73(a)(2)(iv)(A), as an event that resulted in a manual or automatic actuation of the systems listed in paragraph 10 CFR 50.73(a)(2)(iv)(B) (i.e., reactor protection system including reactor scram or trip, and general containment isolation signals affecting containment isolation valves in more than one system).

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FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
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		2007	-- 009	-- 00	

NARRATIVE (If more space is required, use additional copies of NRC Form 366A) (17)

## I. PLANT CONDITION(S)

Prior to the event, Unit 1 was operating at approximately 100 percent of rated thermal power (RTP) (3458 megawatts thermal). Units 2 and 3 were operating in Mode 1 at 100 percent RTP (3458 megawatts thermal). Units 2 and 3 were unaffected by the event.

## II. DESCRIPTION OF EVENT

A. Event:

On October 12, 2007, at 0803 hours central daylight time (CDT), Unit 1 automatically scrambled following a turbine trip from a 1A1 main steam [SB] system moisture separator false high level signal. At approximately 0739 hours CDT, the Unit 1 operator received an alarm indicating a low level in the 1A1 moisture separator drain tank. At 0803 hours CDT, Unit 1 received a moisture separator [SN] 1A1 high level turbine trip signal followed immediately by a reactor scram.

During the scram all automatic functions occurred as expected. All control rods [AA] inserted. The reactor level lowered below level 3, therefore; primary containment isolation system (PCIS) [JM] isolations Group 2 (residual heat removal (RHR) system [BO] shutdown cooling), Group 3 (reactor water cleanup (RWCU) system) [CE], Group 6 (ventilation), and Group 8 (traversing incore probe (TIP) system) [IG] were received along with the auto start of the control room emergency ventilation (CREV) system [VI] and three standby gas treatment (SGT) [BH] system trains. Reactor water level remained above level 2; accordingly, no emergency core cooling systems were actuated. Reactor water level and heat rejection was maintained by the feedwater system [SJ] and condensate system [SD]. Reactor pressure was controlled by the main steam system [JI] bypass valves.

The PCIS actuations were reset by 0808 hours CDT. SGT and CREV systems were secured by 0830 hours CDT.

TVA is submitting this report in accordance with 10 CFR 50.73(a)(2)(iv)(A), as an event that resulted in a manual or automatic actuation of the systems listed in paragraph 10 CFR 50.73(a)(2)(iv)(B) (i.e., reactor protection system including reactor scram or trip, and general containment isolation signals affecting containment isolation valves in more than one system).

B. Inoperable Structures, Components, or Systems that Contributed to the Event:

None.

C. Dates and Approximate Times of Major Occurrences:

October 12, 2007 at 0803 hours CDT	Unit 1 received an automatic reactor scram.
October 12, 2007 at 1007 hours CDT	TVA made a four hour non-emergency report per 10 CFR 50.72(b)(2)(iv)(B) and an eight hour non-emergency report per 10 CFR 50.72(b)(3)(iv)(A).

D. Other Systems or Secondary Functions Affected

None.

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NARRATIVE (If more space is required, use additional copies of NRC Form 366A) (17)

**E. Method of Discovery**

The turbine trip and reactor scram were immediately apparent to the control room staff through numerous alarms and indications.

**F. Operator Actions**

Operations personnel responded to the event according to applicable plant procedures. Operations momentarily entered Emergency Operating Instruction, 1-EOI-1, Reactor Pressure Control, and Abnormal Operating Instruction, 1-AOI-100-1, Reactor Scram, as required.

**G. Safety System Responses**

The RPS [JC] logic responded to the turbine trip per design to initiate the reactor scram. All control rods inserted. The PCIS Group 2 (RHR system shutdown cooling), Group 3 (RWCU system), Group 6 (ventilation), and Group 8 (TIP) isolations were received as expected, due to the lowering of the reactor water level, along with the auto start of the CREV system and the three SGT system trains. Reactor level was automatically restored with reactor feed water; therefore, emergency core cooling system actuation was not required.

**III. CAUSE OF THE EVENT****A. Immediate Cause**

The immediate cause of the reactor scram was a false high moisture separator water level signal. Just prior to the turbine trip a failed level transmitter caused the 1A1 drain tank dump valve to open. This resulted in complete loss of the condensate from the 1A1 moisture separator.

**B. Root Cause**

The root cause for the false high level signal was the float level switch reference leg routing. The high level reference leg is routed to the moisture separator high point vent line a 6 inch pipe, and the low level reference leg is routed to the moisture separator drain piping, an 18 inch pipe.

Additionally, unique to Unit 1 only, the moisture separator high point vent line also has a 3 inch reducer in very close proximity to the turbine trip level switch high reference leg, less than 10 pipe diameters from reducer. Once the moisture separator is void of condensate, high velocity steam flow is established through the moisture separator, the presence of this 3 inch reducer creates a venturi effect on the high level reference leg connection; thus, increasing the differential pressure between the moisture separator and the level control tank. This results in the high level reference leg having a lower pressure than the low level reference leg, thus causing the turbine trip level switch floats to lift to above the trip setpoint.

**C. Contributing Factors**

The moisture separator dump valves are oversized for the plant operating conditions.

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**NARRATIVE** (If more space is required, use additional copies of NRC Form 366A) (17)**IV. ANALYSIS OF THE EVENT**

Six moisture separators remove moisture from the steam exiting the high pressure turbine before going to the low pressure turbines. The condensate level in the moisture separators is controlled by the level in the associated moisture separator level control (drain) tanks. Two Level Indicating Controllers [LIC] are installed on each drain tank. One controls the normal level control valve and the other controls the dump valve. If the normal level control valve cannot maintain normal level (i.e., high condensate level in the level control tank), the dump valve then controls level.

To protect the turbine from excess condensate, a turbine trip is initiated on a high water level in any of the six moisture separators by actuating 2 of the 3 high level turbine trip level switches on each moisture separator.

In the previous event, LER 259/2007-005, the root cause analysis concluded that the trip was caused by the design of the dump valves. Specifically, the valves are oversized. The sizing calculation assumed that the requirements for the dump valves were bounded by the requirements for the normal valves. The investigation into LER 259/2007-005 determined that this led to incorrect design input for sizing the dump valves.

Field testing performed at 100 percent reactor power on November 2, 2007, mechanically restricted the flow through the valve to approximately 70 percent. The test results indicated the turbine trip high level signal would occur even with the reduced valve capacity. Field testing was again performed on November 16, 2007, with the flow restricted to approximately 30 percent. Test results indicated that with the valve flow limited to 30 percent, turbine trip high level signal was not actuated. Additionally, TVA found that the dump valve continued to protect the turbine from water intrusion. Based on the results of the testing, the dump valve travel has been restricted. This action will remain in place until corrective actions to address the root cause of this event are implemented.

TVA postulates that the presence of the 3 inch reducer at the moisture separator vent nozzles on Unit 1 also contributed to the event. The restriction increases the differential pressure between the moisture separator and the moisture separator level control tank once steam flow is established through the vent line and the level control tank. The lower pressure in the level control tank reduces the amount of sub-cooling in the drains, creating unstable conditions in the 18 inch drain pipe from the moisture separator. While this is going on, the venture effect from the 3 inch reducer creates a low pressure zone at the point where the high level reference leg of the level switches connects to the vent pipe. This configuration causes a differential pressure condition that begins to draw unstable condensate from the 18 inch drain pipe into the lower reference leg of the turbine trip level switch, hence causing the false high level signal to be generated.

**V. ASSESSMENT OF SAFETY CONSEQUENCES**

The safety consequences of this event were not significant. The reactor scram was not complicated. All safety systems operated as required. PCIS groups 2, 3, 4, 6, and 8 isolations were as expected. Reactor water level lowered to below level 3, but remained above level 2; therefore, ECCS systems did not actuate. Reactor water level was recovered and maintained by the reactor feed pumps. Operator actions taken in response to the reactor scram were appropriate. These included the verification that the reactor had shut down, the expected systems isolations and indications have occurred, and the restoration of these systems to normal post scram alignment.



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**NARRATIVE** (If more space is required, use additional copies of NRC Form 366A) (17)

Reactor scram from a turbine trip from 100% power is a transient for which BFN is analyzed. Therefore, TVA concludes that the health and safety of the public was not affected by this event.

**VI. CORRECTIVE ACTIONS****A. Immediate Corrective Actions**

Operations personnel placed the reactor in a stable condition in accordance with plant procedures.

**B. Corrective Actions to Prevent Recurrence<sup>(1)</sup>**

To address the root cause and contributors to this event, TVA will relocate the reference legs, both the high and low reference points, for the high level turbine trip instruments. TVA will also eliminate the 3 inch reducer in the 6 inch vent line.

**VII. ADDITIONAL INFORMATION****A. Failed Components**

None.

**B. Previous LERs on Similar Events**

Unit 1 License Event Report 259/2007-005 provides details of an automatic scram from a moisture separator high level signal very similar to the one discussed in this report. The root cause of the report was the sizing of moisture separator dump valve. The valve is oversized for the application. TVA's corrective action to prevent recurrence of LER 259/2007-005 was to evaluate the valve size and either replace or modify the valve. Implementation of the corrective actions would not have prevented the turbine trip and reactor scram discussed in this report.

**C. Additional Information**

Corrective action document for this report is PER 131878.

**D. Safety System Functional Failure Consideration:**

This event is not considered a safety system functional failure according to NEI 99-02

**E. Scram With Complications Consideration:**

This event did not result in a complicated scram according to NEI 99-02.

**VIII. COMMITMENTS**

None.

(1) TVA does not consider these corrective actions as regulatory requirements. The completion of these actions will be tracked in TVA's Corrective Action Program.